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What fails and when? A process view of innovation failure

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ABSTRACT

Research on innovation failure has proliferated lately but with little theoretical attention given to the diversity of the concept. Using process theorizing, we present a model and propositions to understand how a firm's anticipation and value toward failure depends on the type of failure (task versus outcome) and the phase (divergent versus convergent) and point (early versus later) 'within' the process that the failure occurs. Using the anticipation-value stances, we then present a typology of four modes of innovation failure that can arise 'from' task and outcomes failure in the innovation process. The four modes (and associated learning response) are *unsolicited failures* (prevent-alert-eliminate); *hazardous failures* (predict-modify-mitigate); *fortuitous failures* (probe-expose-extrapolate); and *excursive failures* (facilitate-analyze-harness). To help explain the ideas in our process model and typology, we use the well-known IDEO shopping cart innovation project as an illustrative example. Together, these contributions provide contingency oriented insights on how failure varies and journeys within and from the innovation process, which helps researchers and managers to better understand the related causes, effects and learning responses.

1. Introduction

I have not failed. I've just found 10,000 ways that won't work. (Thomas Eddison)

Prior research generally defines innovation failure as an innovation project not attaining desired goals i.e., the outcome from the project was unsuccessful (for a review see: Baxter et al., 2023). This view of innovation includes discontinuing initiatives or new products that fail to meet anticipated objectives (D'Este et al., 2016; Forsman, 2021; Rhaiem and Amara, 2021; Tsinopoulos et al., 2019). Furthermore, such failure is deemed to be common with product and service failure rates at around 40% since the 1960s (Markham and Lee, 2013). Consequently, research has examined how innovation failure spurs firms to learn to innovate more effectively (Cannon and Edmondson, 2005; Khanna et al., 2016; Leoncini, 2016; Maslach, 2016) and how to avoid harmful failures from occurring (Bergek et al., 2008; Klein Woolthuis et al., 2005; Välikangas et al., 2009).

Practitioners also recognize the importance of understanding and dealing with innovation failure. Edmondson (2023, p. 25) quotes a surgeon from a team pioneering heart surgery innovations in the 1950s: "In medicine, we learn more from our mistakes than from our success. Error exposes truth." This quote underscores that innovation failure is often an important source of information that occurs in team-based processes. This innovation practice also reveals that a failed surgical innovation is not just a singular failure but often a series of different failures, each requiring unique behavioral responses.

Despite such practitioner insights about the diversity and dynamics of innovation failure, much of the prior research on innovation failure struggles or neglects to rigorously conceptualize the concept accordingly (Hartley and Knell, 2022; Maslach, 2016). A recent review highlighted this issue, noting "there is limited attention to, and little consensus on, the meaning of innovation failure" and that "the concept is widely used yet poorly defined and frequently lacks any theoretical underpinning" (Baxter et al., 2023, p. 1). This conceptual ambiguity is in part attributed to overly simplistic views of innovation failure being the opposite of innovation success i.e., the termination of initiatives or new products that do not meet expected goals (D'Este et al., 2016; Forsman, 2021; Rhaiem and Amara, 2021).

Furthermore, and per our review, this ambiguity is due to studies taking a 'variance approach' (Whetten, 1989) to understand the effects and learning responses produced by simple uniform conceptualizations of failure. Variance approaches simply assume that failures are present

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or absent, and that the effects are positive or negative. In contrast, a process theorizing approach (Cloutier and Langley, 2020; Langley, 1999; van de Ven, 1992) would examine how failure diversity arises within and from an innovation process. A process model of innovation failure would strive to depict how the concept unfolds and develops as it journeys through the process (Langley, 1999). This treatment of innovation failure relates to two goals of this Special Issue, as well as calls by others (Baxter et al., 2023; Forsman, 2021; Hartley and Knell, 2022; Maslach, 2016) for (i) more nuanced conceptualizations of innovation failure, that (ii) help understand how to capitalize from innovation failure.

We present a process model and propositions to respond to these calls and Special Issue goals. These contributions assert that a firm's anticipation and value toward failure are influenced by the type of failure (task or outcome), and the divergent-convergent nature of the phase and the specific point 'within' the process where the failure occurs. We then present a typology that uses the anticipation-value stances to present four modes (and associated learning responses) of innovation failure that arise 'from' the innovation process: *unsolicited failures* (prevent-alert-eliminate); *hazardous failures* (predict-modify-mitigate); *fortuitous failures* (probe-expose-extrapolate); and *excursive failures* (facilitate-analyze-harness). As our contributions are conceptual, we use examples from the IDEO shopping cart project (Bunderson and Sanner, 2020; ABC Nightline IDEO Shopping Cart, 2009) to illustrate our ideas. We conclude the paper by discussing how our process model and typology offer a contingent framework for researchers and managers to understand the diversity of failure and associated effects and learning responses.

2. Innovation failure: an overview

While failure is a crucial concept within innovation management research, it lacks substantial theoretical development. This has prompted some recent systematic reviews and theoretical developments of the concept. Baxter et al. (2023) review interpretations of the concept, revealing that 'failure' is often just a 'provisional label' for anything that goes wrong with innovation, and that the diversity and process nature of the concept has received little research attention (Baxter et al., 2023, p. 5). From their systematic review Baxter et al. (2023) explain how first-order and second-order aspects of innovation failure combine to reveal three dimensions of innovation failure: experimentation, judgement, and events. Similarly, Reynolds et al. (2023) explain the importance of using process framing to understand innovation failure, and Rhaiem and Amara (2019) highlight the importance of understanding how to learn from failure as a process of steps.

Our scoping review is distinct from this systematic review work in that our review aims to reveal opportunities to theorize about innovation failure rather than answer a question. A systematic review synthesizes research evidence to answer a specific research question about a field of knowledge. For example: How have the concepts of 'frames' been used in innovation failure literature (Reynolds et al., 2023)? In contrast, a scoping review provides an overview of the research to reveal a research question worthy of research attention and will guide theory development (Munn et al., 2018; Arksey and O'Malley, 2005).

Following scoping review guidance (see Munn et al., 2018), the scope of our review was to understand how innovation failure has been conceptualized and theorized so as to identify important gaps and research opportunities. As per Fig. 1, this involved reviewing empirical studies for the period 2000–2023 that focused on failure in innovation, as opposed to research on organizational failure in general (e.g., Dahlin et al., 2018; McMillan and Overall, 2017; Sheppard and Chowdhury, 2005) or other contexts, such as entrepreneurial failure (e.g., Byrne and Shepherd, 2015; Liu et al., 2019; Ucbasaran et al., 2013). The search terms were 'failure', and related terms such as 'innovation', 'product development', 'R&D', 'creativity', and 'technology management'. The search sources were Web of Science, EBSCO, and Science Direct. We

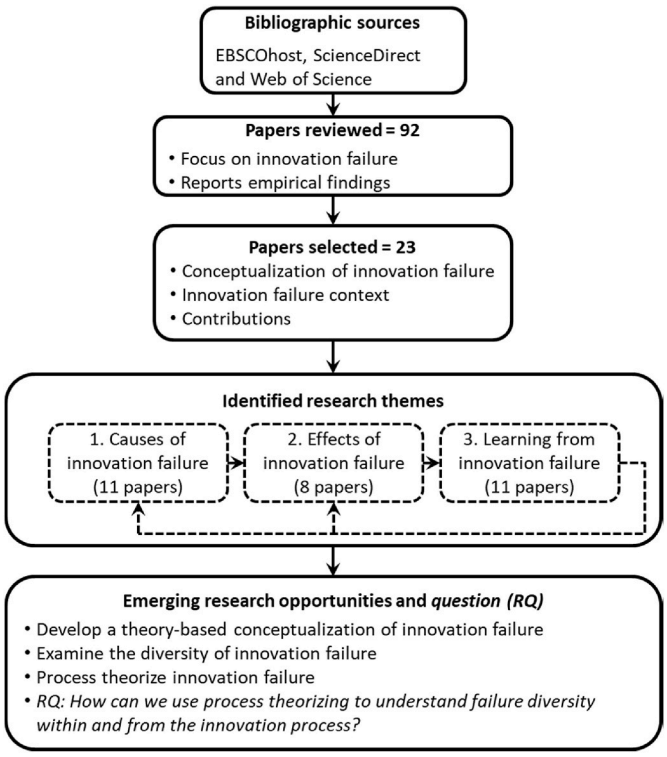
Bibliographic sources
EBSCOhost, ScienceDirect and Web of Science
Papers reviewed = 92
• Focus on innovation failure
• Reports empirical findings
Papers selected = 23
• Conceptualization of innovation failure
• Innovation failure context
• Contributions
Identified research themes
1. Causes of innovation failure (11 papers)
2. Effects of innovation failure (8 papers)
3. Learning from innovation failure (11 papers)
Emerging research opportunities and question (RQ)
• Develop a theory-based conceptualization of innovation failure
• Examine the diversity of innovation failure
• Process theorize innovation failure
• RQ: How can we use process theorizing to understand failure diversity within and from the innovation process?

Fig. 1. Scoping review steps.

reviewed 92 papers and selected 23 papers that fit our review's scope (see Fig. 1 and Table 1). The 23 papers were chosen to reveal differences in the conceptualization of innovation failure (i.e., how it is defined and used), the failure context (i.e., the type of innovation and/or industry), and the key contributions emerging from the study.

Our analysis of 23 selected studies reveals a shift in how innovation failure is perceived over time. Earlier literature primarily viewed failures as something to be avoided (e.g., Rothwell et al., 1974; Ahn et al., 2005; Liao and Cheng, 2014), mostly due to its conceptualization as 'absent from success' (Baxter et al., 2023). In contrast, recent studies emphasize the importance of embracing and learning from failures (Bargoni et al., 2024; Rhaiem and Amara, 2021). Particularly in the last decade, there has been an increase in research focused on learning from and understanding failure. This increase is attributed to recognizing the pro-innovation bias in innovation research, which had previously hindered a more detailed examination of failure (Vinck, 2017; Baxter et al., 2023). However, both perspectives still overlook a key aspect – that failures can be beneficial or detrimental, depending on the specific context and timing of their occurrence. We identified three themes from the selected studies to characterize how research has examined innovation failure. The knowledge from these themes feeds into each other to produce a body of knowledge on what causes innovation failure (Theme 1), what are the consequences of innovation failure (Theme 2), and what are the learning responses to innovation failure (Theme 3). Some studies (e.g., Välikangas et al., 2009; Maslach, 2016; Leoncini, 2016) focus on two themes.

Theme 1 studies (causes of innovation failure) investigate the reasons for innovation failure – either from a firm-level or a market viewpoint. Firm-level factors include financial constraints, especially at the inception stage of an innovation project (García-Quevedo et al., 2018), international diversity of a firm's locations (Santamaría et al., 2021), and a firm's lack of operational experience (Leoncini, 2016). Market-related factors for innovation failure include a concentrated market structure and lack of demand (Pellegrino and Savona, 2017), government or environment-related factors that decrease market attractiveness (Ahn et al., 2005), and being unable to align innovation

Table 1
Innovation failure studies in management research.

Sample Studies	Conceptualization of innovation failure	Innovation failure context	Contribution	Innovation failure theme
Ahn et al. *(2005)*	Either a terminated service or a currently active service that showed poor performance in the past and is expected to be poor even in the future from customer, financial, and product-level perspectives.	Causes of failures in Korean telecommunications service industry.	Identification of organizational, marketing, and technological factors that cause innovation failure.	Causes of innovation failure
Bargoni et al. *(2024)*	Market-related aspects, such as a firm's marketing abilities and competitive position, and organizational factors impede innovation.	Firms implementing growth hacking strategies to fuel innovation	Importance of adopting growth hacking practices to minimize the likelihood of innovation failure.	Learning from innovation failure
Cannon and Edmondson (2005)	Large and small failures in domains ranging from technical errors to interpersonal mistakes.	Identifying and analyzing change from failures across the organization.	Recommendations for overcoming the barriers to learning from failure: firms should learn to fail intelligently (e.g., by experimentation) as a deliberate strategy to promote innovation and improvement.	Learning from innovation failure
Dana et al. *(2021)*	Innovation is not delivered; termination of innovation project.	Grassroots innovations that address local challenges and opportunities.	Recommends using diagnostic tools and practices for social inclusion to avoid failure.	Causes of innovation failure; Learning from innovation failure
Danneels and Vestal (2020)	Actions are considered failures when their outcomes fall short of expectations.	New product development by manufacturing firms headquartered in the U.S.	A mere tolerance for failure does not affect firm product innovativeness, but firms that deliberately analyze past failures introduce more innovative new products.	Effects of innovation failure; Learning from failure
Ederer and Manso (2012)	Product innovations do not meet expectations (= negative customer feedback).	Controlled laboratory experimental setting with managing a lemonade stand.	Tolerance for early failure and reward for long-term success effectively motivate innovation.	Learning from failure
Eggers (2012)	Investing in losing technologies.	Technological investment in the global flat panel display industry.	Firms that invest in the wrong technology will be less successful when working with the winning technology, and classic risk-reducing strategies are ineffective.	Causes of innovation failures; learning from failure
Ferreira et al. *(2020)*	Abandoned or suspended innovation projects before completion.	Innovation by firms in the European Union (CIS innovation survey).	Innovation failure is negatively correlated with companies' experience and external knowledge acquisition.	Effects of innovation failure
Forsman (2021)	Failed innovation initiatives.	The perceived factors of innovation failure in SMEs.	The occurrence of several incidents during the innovation process slowly contributes to complete failure.	Causes of innovation failure
García-Quevedo et al. *(2018)*	When a firm abandons an innovation project.	Innovation projects by firms in the manufacturing and service sector (Spanish Technological Innovation Panel).	Financial obstacles impact innovation failure depending on the innovation stage; in the conception stage, financial constraints have the biggest impact on the likelihood of innovation failure.	Causes of innovation failure
Heidenreich and Kraemer (2016)	Unsuccessful market introduction, i.e. rejection of customers.	A scenario-based online experiment in consumer electronic product category.	Consumers' passive innovation resistance as a dominant barrier to innovation adoption; this can be overcome by the marketing instruments mental simulation and benefit comparison.	Causes of innovation failures
Leoncini (2016)	Innovation being abandoned after making an effort to innovate.	Community Innovation Survey 2008; CIS 2008) – a harmonized survey questionnaire coordinated by Eurostat (OECD/Eurostat, 2005).	Failure is negatively correlated to the firms' operating experience and the acquisition of direct external knowledge; failure, in turn, positively impacts performance in terms of the percentage of turnover from new innovative products to the market.	Causes of innovation failures; Effects of innovation failure
Liao and Cheng (2014)	Failure of an innovation to meet consumers' expectations regarding new product functions or performance.	An experimental study with the scenario of a brand's Bluetooth virtual keyboard innovation and the failure of this.	High-equity brands suffer less than low-equity brands from the adverse effects of innovation failures.	Effects of innovation failures
Liao et al. (2015)	Service innovation failure characteristics include (1) functional barriers, (2) psychological barriers, (3) dysfunctional service behavior.	A scenario-based online survey about service innovations.	Unsuccessful service innovation may give rise to adverse behavioral and relational consequences among consumers.	Effects of innovation failures
Maslach (2016)	Adverse new product events that lead to injury or death.	Medical devices sold in the U.S.	Firms change innovation activities when novel innovations fail but persist when incremental innovations fail.	Effects of innovation failure; Learning from innovation failure
Pellegrino and Savona (2017)	Innovation inputs that did not translate into a new marketable product/process.	U.K. Community Innovation Survey (CIS) merged with data from the U.K. Business Structure Database.	Demand-side factors, particularly concentrated market structure and lack of demand, are as important as financial constraints in determining firms' innovation failures.	Causes of innovation failures
Qin and van der Rhee (2021)	Previously rejected projects in NPD portfolios.	Focus group interviews with innovation experts.	A systematic review of the new product development literature; development of a checklist for innovation failure detecting value of failed innovation projects (trash or treasure).	Learning from innovation failure

(*continued on next page*)

Table 1 (*continued*)

Sample Studies	Conceptualization of innovation failure	Innovation failure context	Contribution	Innovation failure theme
Rhaiem and Amara (2021)	An event that rectifies an innovation project.	436 manufacturing SMEs in Canada.	Learning from innovation failure is explained by organizational (problem-solving, blaming, psychological safety), interactional (trust among employees), and individual factors (personal mastery).	Learning from innovation failure
Rothwell et al. *(1974)*	Commercial success or commercial failure.	Chemical industry and scientific instrument industry.	Five main areas of difference between successful and unsuccessful innovators are (1) user needs, (2) efficiency of development, (3) characteristics of managers, (4) efficiency of communications, and (5) marketing and sales efforts.	Causes of innovation failure
Tao et al. *(2023)*	The percentage of prior project failures in a project portfolio and the time elapsed since the last project failure.	Technology-based new product development projects in high-tech ventures.	As the rate of project failures increases, learning from these failures becomes harder, but improving error-handling skills can lessen this. Also, learning from failure is more likely the longer it has been since a project failed.	Learning from innovation failure
Santamaría et al. (2021)	The activity initiated by the firm to develop or apply an innovation has been stopped (i) in the design stage or (ii) after beginning the project.	Manufacturing and services firms.	Beyond a certain threshold, international diversity begins to act as a brake on innovation success and to increase the likelihood of failure (importance of geographic location when choosing collaboration partners).	Causes of innovation failure
Välikangas et al. *(2009)*	Product innovations do not meet market expectations.	Computing innovation at Sun Microsystems.	Failure can lead to innovation trauma and the inability to commit to innovations; overcoming innovation trauma is a critical but underappreciated aspect in companies that depend on continuous innovation for their competitiveness.	Effects of innovation failure; Learning from innovation failure
Victory et al. *(2021)*	Permanent cessation of sales for new products one and two years after launch.	Consumer packaged goods.	Reporting of data on how common new product failure is; i.e., one in four (25%) new SKUs fail one year after their introduction and, in the second year, the cumulative new SKU (stock-keeping units) failure rate reached approximately 40%.	Effects of innovation failure

and marketing efforts with consumer demands (Heidenreich and Kraemer, 2016; Rothwell, 1994; Ahn et al., 2005). These studies try to uncover primary organizational and market causes of innovation failure in terms of what went wrong, what was too late, and what was present or absent.

Theme 2 studies (effects of innovation failure) examine how firms view and are impacted by the concept. On the one hand, consistent with research on organizational failure (Dahlin et al., 2018; Sitkin, 1992), some studies view innovation failure as a negative. Failure is deemed risky, damaging and traumatic, making it challenging for firms to analyze and respond (Danneels and Vestal, 2020; Forsman, 2021; Välikangas et al., 2009). Similarly, it is suggested that the negativity associated with innovation failure shapes aversion to future innovation attempts (Shepherd and Kuratko, 2009; Välikangas et al., 2009). In contrast, studies also positively view innovation failure as a trigger to improve innovation performance (Cannon and Edmondson, 2005; Ederer and Manso, 2012; Ferreira et al., 2020). In line with this, we observe a continued dominance of the variance perspective when researching the effects of innovation failure, with studies often categorizing it as either exclusively positive or exclusively negative.

Theme 3 (learning from innovation failure) concerns how firms respond to the causes and effects of innovation failure. For example, the responses firms adopt to avoid innovation failure (e.g., Cannon and Edmondson, 2005; Välikangas et al., 2009) and understand the impacts of this learning (e.g., Rhaiem and Halilem, 2023; Dana et al., 2021). This theme also considers the extent to which learning approaches are forward-looking to predict and minimize idea selection failures for future projects (Eggers, 2012), or backward-looking to assess innovation projects that did not deliver expected outcomes (Greve, 2003). Studies in this theme also show that learning is enhanced when focused on problem-solving instead of assigning blame for innovation failure (Rhaiem and Halilem, 2023). Similarly, Cannon and Edmondson (2005) describe recommendations for overcoming the barriers to learning from failure and the need for more experimentation to fail intelligently. To help firms learn from innovation failure, a few studies propose checklists (Qin and van der Rhee, 2021) or diagnostic tools (Dana et al., 2021). Also, many of the learning studies exemplify the variance approach as they first link to Theme 2 by evaluating failure by categorizing it as either positive or negative, which is a variance approach.

Three research opportunities and a research question emerged from examining these themes and studies. The first opportunity is that there has been limited theorizing about the innovation failure concept. The review by Baxter et al. (2023) also notes this. Theorizing about innovation failure provides organization and utility about what we believe to be true about the concept. The resulting conceptualization and reasoning about innovation failure helps researchers develop better classifications, descriptions, explanations, and predictions about the nature and impact of the concept. Good theorizing provides a logic to support the elements in empirical examinations of innovation failure.

A second related opportunity, and as noted by others (Baxter et al., 2023; Hartley and Knell, 2022; Maslach, 2016; Vinck, 2017), is a paucity of research about the diversity of innovation failure. Many of the studies in Table 1 simply conceptualize innovation failure as 'not innovation success' (Baxter et al., 2023). This view of the concept is possibly due to a long-standing pro-innovation bias (Rogers, 1983) that has steered scholars to focus on how to innovate successfully (Godin and Vinck, 2017). For example, many studies in Table 1 conceptualize innovation failure as an abandoned innovation project or an initiative that does not progress beyond the innovation development stage (e.g., Forsman, 2021; Leoncini, 2016; García-Quevedo et al., 2018). These studies view innovation failure as not generating a successful output from the innovation process but do not consider how failure arises within and from the process. From a market perspective, innovation failure is also conceptualized as an unsuccessful introduction to the market (e.g., Heidenreich

and Kraemer, 2016; Välikangas et al., 2009; Victory et al., 2021). While these conceptualizations are useful for understanding innovation failure as unsuccessful attempts to innovate, they do not consider how failure arises within and from the innovation process.

Third, while there are a few studies in Table 1 that use process steps to frame cases of innovation failure (i.e., Ahn et al., 2005; García-Quevedo et al., 2018; Qin and van der Rhee, 2021), they do not offer conceptual or process theoretical insights about the diversity of innovation failure. This is because most of the studies in Table 1 are variance in nature (Whetten, 1989), focusing on uniform causes (Theme 1) and consequences (Themes 2 and 3) of innovation failure. In other words, as explained by Lei and Naveh (2023), studies dealing with failure are typically rooted in a simple binary (i.e., occurs or not) conceptualization of failure that does not consider the nature of failure at different points in time. Thus, there is an opportunity to develop a process theoretical understanding of how different innovation failures arise within and from the process. Exploring innovation failure diversity across different process phases can help to overcome partial and oversimplified pictures of the concept (Langley and Tsoukas, 2010; Tsoukas and Hatch, 2001).

The following research question captures these three research opportunities from our scoping review: *How can we use process theorizing to understand failure diversity within and from the innovation process?* This question motivates our process model on how failure unfolds within an innovation process and guides our typology on how four modes of failure arise from an innovation process and the associated learning responses. By process theorizing about the diversity of innovation failure, we seek to provide researchers with a conceptualization, framework, reasoning, and terminology to motivate and guide rigorous and useful empirical examination of the concept to better explain how managers make sense of and deal with innovation failure.

3. The nature and impact of innovation failure

In this section, we use process theorizing to conceptualize innovation failure as two types of failure (i.e., task and outcome failures) that can occur at different phases of the innovation process. From this, we offer propositions as to the extent to which firms anticipate and value these different types of failure during the process. Then, using the anticipate-value stances and ideas established in the process model, we present a typology of four modes of innovation and associated learning responses.

3.1. A process view of innovation failure

Process theorizing involves addressing questions about how and why things emerge and vary over time (Langley et al., 2013; Mohr, 1982). Cloutier and Langley (2020) explain that an advantage of such theorizing is that scholars can borrow and apply process models developed and used for other research concepts as long as the model is useful for theorizing the concept to be studied. For example, the four-stage life-cycle model of technology ventures was borrowed to theorize how entrepreneurs acquire and manage organizational legitimacy over time (Fisher et al., 2016). Similarly, the 'idea journey' process was used to understand how the utility of social networks for creativity can vary over time (Perry-Smith and Mannucci, 2017), and technology commercialization process stages were used to study the drivers and importance of licensing speed (McCarthy and Ruckman, 2017).

To process theorize about the nature and impact of innovation failure, we are fortunate that it is common to view innovation as a series of phases with tasks, decisions, and outputs at each phase (see Eveleens, 2010; McCarthy et al., 2006 for reviews of innovation models). Many of these models are used for framing and teaching innovation management (e.g., Tidd and Bessant, 2020; Cooper, 1986; Hansen and Haas, 2001), but none, as far as we know, have been used for theorizing about innovation failure. We use the influential 'double-diamond' model of innovation (Design Council, 2022) as it is one of the earliest models, and it considers the divergence and convergence of dealing with both problems and solutions (see Fig. 2). Before expanding on these reasons for using the double-diamond model, it is crucial to understand how the model conceptualizes the innovation process.

The two diamonds in the model show how thinking and outputs at different points in the innovation process are generated in a divergent way and then selected in a convergent way (Marion et al., 2023; Marion and Fixson, 2019). The first diamond in the model represents the problem space for the innovation process. During this diamond's divergent phase (i.e., left half), innovation involves discovering problems that motivate and guide the innovation project. For example, a project to redesign a shopping cart (we use this example to illustrate our process model and typology in the next section) would involve consulting with different stakeholders who use, own, and manufacture shopping carts to learn about their problems with existing shopping carts. The first diamond's convergent phase (i.e., the right half) involves gathering, merging, and 'narrowing down' the previously identified problems. Sticking with the shopping cart example, the convergent phase involves assessing, combining, reducing, and selecting the problems with existing shopping carts to define the goals of the innovation project.

The second diamond in the model represents the solution space. The first phase of this diamond (i.e., the left half) depicts the divergent nature of innovation as generating potential solutions to address the project goals. For example, innovation team members brainstorm, adapt, share, and iterate on various solutions to address the shopping cart safety, maneuverability, storage, and security problems. The convergent phase of the second diamond (i.e., the right half) is where innovation team members 'close down' on promising solutions. They evaluate and test cart design prototypes, refine the solutions, and use the learning and decisions in this phase to converge on and develop a final solution.

With this account of the double-diamond model, we chose it for the following reasons. First, it is one of the earliest process conceptualizations of innovation and thus either underpins and or provides similar process framing insights to the many models that have emerged since. The model was popularized by the UK's Design Council in 2005 (Design Council, 2022), but its origins are attributed to earlier research on the dynamics of innovation thinking styles (Guilford, 1956) and design (Banathy, 2013). More specifically, while other innovation process models focus just on revealing functional activities in the process (e.g., Cooper, 1986), the double-diamond model also reveals how divergent-convergent and problem-solution thinking styles vary within the process (Bouschery et al., 2023; Marion et al., 2023; Marion and Fixson, 2019).

The divergent-convergent focus of the double-diamond model is suited to contingency (Donaldson, 2001) and process theorizing (Cloutier and Langley, 2020). This is because changes in divergent-convergent thinking are useful for understanding the emergence and variation of concepts – such as types of innovation failure - within the process over time. Given that process theorizing involves understanding how a concept may vary during a process (Mohr, 1982; Langley, 1999), the divergent-convergent aspects of the double-diamond model reflect conditions that likely influence how we should view and respond to innovation failure. In contrast, other innovation process models either do not explicitly portray how divergent-convergent thinking changes across the process (e.g., Tidd and Bessant, 2020; Hansen and Haas, 2001), or only consider the convergent aspects such as the funneling and filtering of innovation ideas (e.g., Clark and Wheelwright, 1992; Docherty, 2006).

Furthermore, as the double-diamond framework models the innovation process in terms of a problem space and a solution space, this helps understand innovation failure as a process of discovering, understanding and defining potential problems, *and* producing, selecting and delivering solutions (Bowers and Khorakian, 2014). As the problem and solution spaces involve different approaches to creativity, they are also useful for understanding the causes and consequences of innovation

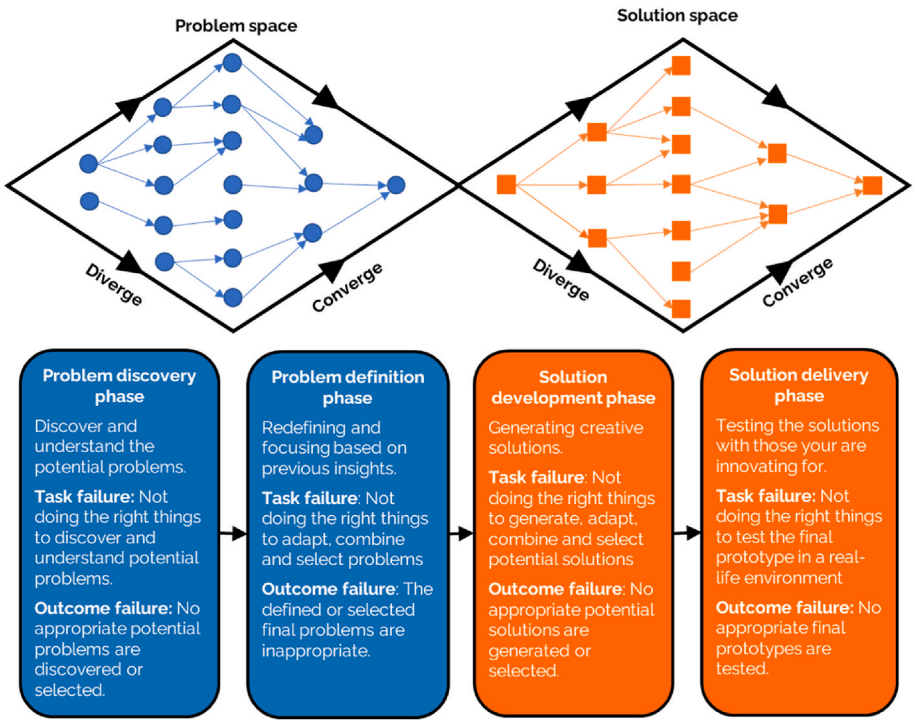
Problem space
Solution space
Diverge
Converge
Diverge
Converge
Problem discovery phase
Discover and understand the potential problems.
Task failure: Not doing the right things to discover and understand potential problems.
Outcome failure: No appropriate potential problems are discovered or selected.
Problem definition phase
Redefining and focusing based on previous insights.
Task failure: Not doing the right things to adapt, combine and select problems
Outcome failure: The defined or selected final problems are inappropriate.
Solution development phase
Generating creative solutions.
Task failure: Not doing the right things to generate, adapt, combine and select potential solutions
Outcome failure: No appropriate potential solutions are generated or selected.
Solution delivery phase
Testing the solutions with those your are innovating for.
Task failure: Not doing the right things to test the final prototype in a real-life environment
Outcome failure: No appropriate final prototypes are tested.

Fig. 2. Process model of innovation failure.

failure (i.e., the themes in Table 1) as well as understanding the role of risk-taking, hypotheses testing, and novelty management in innovation failure (Bledow et al., 2009; Miron-Spektor et al., 2011). In contrast, other popular process models focus on solution development only (e.g., Cooper, 1986; Hansen and Haas, 2001).

3.2. Failure types within the innovation process

Failure, in general, is defined as a deviation from desired goals (see also: Dahlin et al., 2018; Reason, 1990; Sitkin, 1992; Zhao and Olivera, 2006). This definition is consistent with the process level and output-oriented definitions of innovation failure listed in Table 1. However, from a within process perspective, failure can be task and outcome-oriented (Dahlin et al., 2018; Frese and Keith, 2015; Lei and Naveh, 2023). *Task failures* are not doing the right innovation process tasks with the right people in the right way. This type of failure is an action error in that some deviation from a task-based rule or standard has occurred (Frese and Keith, 2015). Furthermore, context matters when it comes to understanding this type of failure and its consequences, as process conditions influence an individual's capacity to produce task failures (Goodman et al., 2011). *Outcome failures* are a lack of outcomes or producing and choosing erroneous outcomes within some phase of the process. Outcome failures often result from one or more task failures, but not every task failure results in an outcome failure (Hofmann and Frese 2011). For example, forgetting to consider a safety standard when developing a cart solution might not result in an adverse outcome, as it will depend on the nature of the solution and its application in the innovation. Consequently, we define *innovation process failure* as involving one or more task failures and outcome failures combined within the process to result in a mode of failure that prevents the attainment of expected innovation goals.

By recognizing task and outcome failures within the innovation process, we can explain how they and associated stances can vary at different process phases. To do this, we provide a running illustrative case. This is not done to test our ideas but to illustrate them and the associated variations and contingencies in our model, and later in the typology. Using a single illustrative case helps readers have "a much easier time imagining how the conceptual argument might actually be applied to one or more empirical settings" (Siggelkow, 2007, p. 22). Our illustrative case is the shopping cart project by IDEO, a leading design and innovation consulting company (Bunderson and Sanner, 2020). A video of this case was studied as part of a video ethnographic development of the ideas in this paper. The video provides a 'fly on the wall' style documentary showing an IDEO innovation team working on developing a new shopping cart. The video shows the team's design endeavors, starting from the initial brainstorming phase to the development of a functional product. This publicly available video is appropriate for illustrating our ideas as readers can use it to observe activities, successes, and types of failures across process phases.

Using the IDEO video, Table 2 provides examples of task and outcome failures across all four process phases. The task failures in Table 2 involve incorrectly executing appropriate tasks, doing inappropriate tasks, and involving the wrong individuals in the task. For example, during the problem discovery phase, IDEO team members might rely on hearsay or single reports about cart use, instead of conducting direct observations at the shopping center. During the solution delivery phase, the illustrative example could be no cart prototypes being produced or selected or inappropriate prototypes being selected. In contrast, outcome failures occur when incorrect results are generated and selected. For example, during the problem definition phase, the IDEO team might deviate from compulsory issues, exploring irrelevant or minor aspects, diluting their efforts and impeding effective solution development. During the solution development phase, an outcome failure would involve team members not producing or selecting cart solutions or selecting solutions that do address the innovation goals.

3.3. Anticipating and valuing types of innovation failure

We now explain how individuals involved in an innovation process can anticipate and value innovation failure differently depending on where the failure occurs within the innovation process. These process-based explanations help to understand how firms can respond to failure at different points in the innovation process.

Failure anticipation is the extent to which individuals expect to

Table 2
Task and outcome failures at different process phases illustrated using IDEO shopping cart case examples.

Types of failure within the innovation process		
Process phases	**Task failures** *Not doing the right tasks, in the right way, with the right people.*	**Outcome failures** *Producing and choosing erroneous outcomes.*
Problem discovery (Discover and understand the potential problems with carts)	• Not going into stores and observing cart use. • Not seeking 'evidence', such as the number of cart thefts or the number of hospitalized injuries from using carts.	• No problems with existing carts are discovered. • The discovered problems about carts are not real or significant.
Problem definition (Redefine and focusing the cart problems)	• 'Drifting away' from the core identified problems (i.e., theft, usability and safety) that motivate the cart project. • Forgetting the store owner's perspective.	• The defined problems and associated opportunities do not appeal to the cart makers, owners, and users.
Solution development (Generating creative solutions for a new cart)	• Not brainstorming or doing it wrong, i.e., not encouraging 'wild' ideas (such as using a device to mimic telecommunication with shop staff). • Choosing unfeasible ideas, i.e., ideas that can't be developed within the technical, time or cost constraints.	• Not producing or selecting solutions. • Selecting solutions that don't address defined problems (e.g., the 'sports utility cart').
Solution delivery (Testing the solutions with users, owners and manufacturers of carts)	• Not doing prototyping or doing it wrong (e.g., working on too few or too many prototypes). • Neglecting to involve store employees in the process of using and stacking the cart can impede the innovation process.	• No prototypes were produced or selected. • Selecting prototypes that don't address defined problems. For example, the 'cart prototype with privacy screen for condoms' is selected, or the cart prototypes are not 'stackable'.

focus on and attend to a failure at different phases in the innovation process (Rybowiak et al., 1999). This stance can be explained using the attention-based view of the firm (Ocasio, 1997) which asserts that the attention individuals allocate to organizational issues is a limited and valuable resource. There are two key premises to the allocation of attention. One is focus, where individuals selectively concentrate their attention to anticipate specific issues (i.e., failures) according to the situation (Ocasio, 1997; Brielmaier and Friesl, 2023). For example, an attention-based view to anticipating and dealing with crises (i.e., rare and significant failures) highlights that the focus, rather than the quantity of stakeholder attention, is what helps firms anticipate and deal with crises (Kudesia and Lang, 2023). With innovation failures, attention impacts the degree of anticipation directed towards the possibility of failure (i.e., attention intensity) and the openness to anticipating different types of failure (i.e., attention breadth) (Brielmaier and Friesl, 2023).

The second key premise of the attention-based view is that anticipation is situated (Ocasio, 1997; Brielmaier and Friesl, 2023). In the context of process theorizing innovation failure, situated means that an individual's focus on and anticipation of innovation failure depends on the point in the innovation process, rather than purely on the characteristics of the individuals working in the process. Furthermore, the structure of attention varies throughout the phases of the innovation process. These attention structures are behavioral and social factors in a process that can regulate and direct attention (Brielmaier and Friesl, 2023). For example, the probing, experimenting, and creative nature of the divergent phases in an innovation process will work to make individuals anticipate failure. In contrast, the selection, filtering and finalizing aspects of divergent phases work to structure less attention to failure anticipation.

The ***failure value*** stance is the extent to which individuals in an innovation process attribute value to different innovation failures within the innovation process. This stance can be explained by attribution theory, which concerns how individuals interpret and respond to success and failures (Dahlin et al., 2018; Ilgen and Davis, 2000; Weiner, 1972). By theorizing about innovation failures, we consider an internal locus of causal attribution. This means we focus on attributing failure within and from the process to individuals involved rather than other factors such as industry and economic forces. When individuals involved in the process anticipate or experience something going wrong, the resulting positive or negative attribution to it, then shapes subsequent behavior, motivations, thoughts, and emotions (Kelley, 1967; Weiner, 1972; Kasof, 1995). Given that innovation failure appears at different divergent-convergent stages throughout the innovation process, the attributions assigned to these failures also differ depending on the process phase. When a positive aspect is attributed to a detected failure, learning from these failures encompasses anticipating them and embracing the opportunity to derive valuable lessons. However, attributing value to failure can be challenging as organizational members tend to attribute success to internal factors like ability and effort, and failure to external factors such as bad luck (cf. Jones and Harris, 1967).

From a process theorizing perspective, we suggest that the anticipation and value stances vary according to the types of innovation failure that occur *and* will vary across the divergent-convergent phases, and how far into the innovation process. The effects of types of innovation failure on stances is a core premise of our model, with individuals more likely to anticipate and value task failures than outcome failures for two reasons. First, task failures are more numerous and more likely to be anticipated. Research shows that people make two to four task failures per hour during routine work and that the number of task failures increases with the complexity and novelty of the work (Frese and Keith, 2015). Second, as stated earlier, one or more task failures can often underly outcome failures (Hofmann and Frese 2011). This increases the likelihood that individuals involved in an innovation process will anticipate and appreciate the actions of detecting and learning from task failures, which could otherwise lead to outcome failures.

To explain the effects of divergent phases versus convergent phases on the stances, we offer propositions. Specifically, we suggest that as innovation activities in the phases vary, this impacts the likelihood that individuals in the process will anticipate and value failure at that point in the process. During both the divergent phases of Fig. 2, the innovation tasks are more experimental, creative and risky. They involve brainstorming, ideation sessions, mind mapping, and other creative tasks to generate and open-up a range of ideas, perspectives, and possibilities for understanding the innovation problem and subsequent solution. The probing and exploratory nature of the divergent phases means that they are more likely to increase a firm's exposure to failure (D'Este et al., 2017). This is because failure is to be anticipated during the tasks of exploring problems and solutions and less anticipated in the convergent phases, where tasks are concerned with the analysis, assessment, and selection of solutions and problems (Christensen et al., 2018). During the divergent phases, attention is contingent on the phase situation, with an increased emphasis on detecting potential failures. Moreover, attributions to detected failures are more likely to be positive during the divergent phases, where exploration and broad thinking are encouraged. Thus, a firm is more likely to anticipate and value failure in the divergent phases than the convergent phases (see Proposition 1 below and as P1 in Fig. 3).

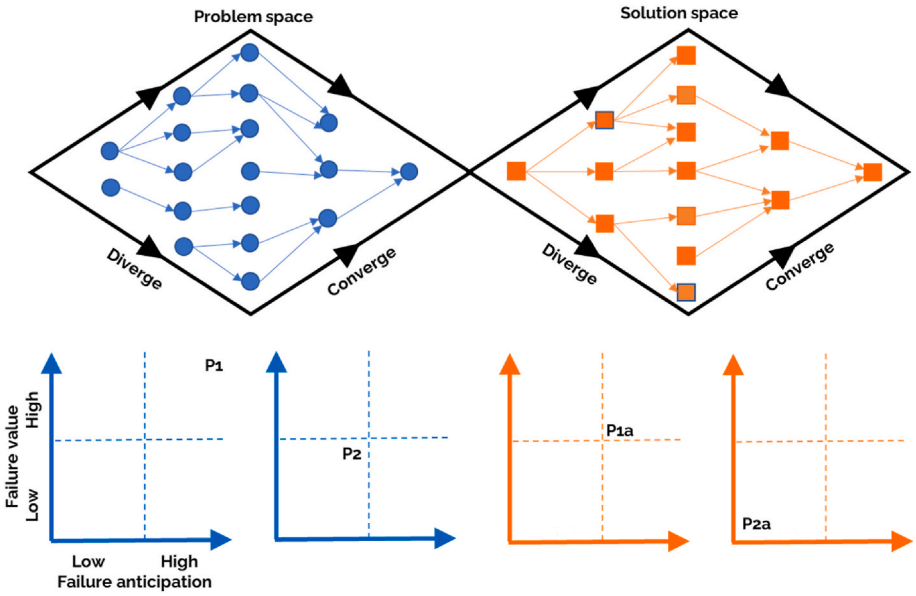

Fig. 3. Anticipating and valuing types of innovation failure.

Proposition 1. *Anticipation and value of task and outcome failures are more likely in the divergent phases of the innovation process.*

The convergent phases that follow divergent phases focus on prioritizing and selecting the generated problems and solutions from the divergent phases (Marion et al., 2023; Marion and Fixson, 2019). The tasks in these convergent phases are refinement and filtering in nature and guided by feasibility, desirability, and viability. Rules, costs and standards are followed to prototype, test and select acceptable problems and solutions. The tasks in convergent phases are more constraining and safer than those in divergent phases. Moreover, the attributions assigned to the causes of failure are likely more negative in the convergent phases than in the divergent phases. This is because the focus in the convergent phases is more on implementation and feasibility rather than on testing and probing. Thus, relative to the divergent phases, the likelihood of failure anticipation and value decreases as ideas are refined, and decisions are made (see Proposition 2 below and as P2 in Fig. 3).

Proposition 2. *Anticipation and value of task and outcome failures are less likely in the convergent phases of the innovation process.*

The positions of the different phases in the process will also impact the likelihood that innovation failure will be anticipated and valued. As an innovation initiative progresses through the four process phases, more money and time will be spent on the initiative. These sunk costs create a psychological barrier that binds and blinds individuals to facing innovation failure, reducing the likelihood of innovation failure being anticipated and valued (Manez et al., 2009). This is why innovation initiatives are more likely to be shut down in the early phases of the process, than the later phases (Schmidt and Calantone, 1998). Consequently, we suggest that the stance likelihoods outlined in propositions 1 and 2, will become less during the later phases (i.e., the second diamond) in the process. As a project advances from the first diamond to the second, the greater the sunk costs, the lower the appetite for creativity and risk and the lower the anticipation and value of innovation failure. Thus, the stances shift from failure expectancy during the first diamond phases towards success attainment in the second diamond phases. This shift decreases anticipation and value assigned to innovation failures in the last two phases of the innovation process. This process-based view of how the phases in the second diamond modify propositions 1 and 2 is stated in propositions 1a and 2a below and shown as P1a and P2a in Fig. 3.

Proposition 1a. *Anticipation and value of task and outcome failures are less likely in the solution space divergent phase than in the problem space divergent phase.*

Proposition 2a. *Anticipation and value of task and outcome failures are less likely in the solution space convergent phase than in the problem space convergent phase.*

3.4. A typology of failure modes and responses

To help understand how firms might capitalize on innovation failure, the ideas and constructs from our process model are now 'theoretically clustered' (Cornelissen, 2017) to produce a typology of innovation failure modes and associated learning responses. This typology is an 'integrative theory' building tool (Fiss, 2011) that links our ideas on types of innovation failure within a process to four modes of failure arising from the process: *unsolicited failures*, *hazardous failures*, *fortuitous failures*, and *excursive failures* (see Fig. 4). We use the term 'mode' from

	Fortuitous Failures	Excursive Failures
High	***Definition***: Unforeseen advantageous failures that happen by accident or chance, rather than by design. ***Response:*** Probe-expose-extrapolate.	***Definition***: Hoped for beneficial failures pursued via exploration and experiments. ***Response***: Facilitate-analyse-harness.
Low	**Unsolicited Failures** ***Definition***: Unintended and unwanted failures due to sloppiness and inability. ***Response***: Prevent-alert-eliminate.	**Hazardous Failures** ***Definition***: Expected harmful failures due to uncertainty. ***Response***: Predict-modify-mitigate.

Failure value (High / Low)

Low **Failure anticipation** High

Fig. 4. Typology of innovation failure modes.

quality management, where 'failure modes' refer to how something (e.g., a process or product) might fail and its impact (Stamatis, 2003). Thus, each failure mode in our typology is a way that innovation process failure can occur from task and outcome failures, based on our process and theoretical reasonings, rather than an exhaustive taxonomy of all modes of innovation failure. Drawing on research about the scanning-interpretation-learning capabilities of organizations (Daft and Weick, 1984; Choo, 2001), we also suggest an appropriate learning-based response for each mode.

The first innovation failure mode we propose is when the likelihood of failure anticipation and failure value are both low. We call these *unsolicited failures*. This mode of failure is unwanted in that it is not expected, and if it does occur, it offers limited learning value and may even be harmful. Unsolicited failures occur when there is a lack of attention, diligence, or competency in essential innovation tasks. These failures are unwelcome as they hinder progress and often lead to wasted resources, missed opportunities, and even reputational damage. They include failures such as botched target market research (Chiesa and Frattini, 2011), where insufficient efforts were made to learn from customers, get feedback, get approval, or check for competing products. Analytical learning, distinct from learning-by-doing, is necessary here, where information from previous incidents is utilized to create new routines for future use (Dahlin et al., 2018; Reason, 1990).

Continuing with the IDEO shopping cart example, unsolicited failure would be if the cart was designed to meet the core need of being nested or stackable for storage purposes but failed to deliver this satisfactorily (see Fig. 5). This failure mode may arise during the cart's solution development phase, where the engineering drawings may appear to meet the nesting requirement. However, due to insufficient testing using a single prototype primarily with supermarket customers and without involving supermarket employees, the inability of the cart to nest correctly has not been discovered.

An appropriate learning response to this mode of failure is to have *prevent-alert-eliminate* practices in the innovation process. Prevention involves regular and routine checks and training to ensure correct innovation tasks are done well. Like preventative care in operations management, the schedule of the checks and training can be time-based (e.g., once a week), progress-based (e.g., at phases of the process), or frequency-based (e.g., every two projects) (Tinga, 2010). Alerting involves process control mechanisms to signal to innovation team members that this mode of failure has occurred, to prevent the process from proceeding, and to help eliminate reoccurrences. These three activities

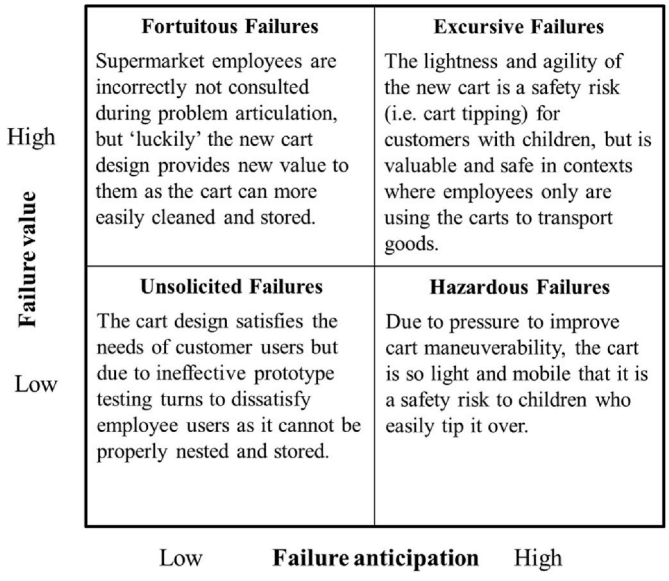
Fortuitous Failures
Supermarket employees are incorrectly not consulted during problem articulation, but 'luckily' the new cart design provides new value to them as the cart can more easily cleaned and stored.
Excursive Failures
The lightness and agility of the new cart is a safety risk (i.e. cart tipping) for customers with children, but is valuable and safe in contexts where employees only are using the carts to transport goods.
Unsolicited Failures
The cart design satisfies the needs of customer users but due to ineffective prototype testing turns to dissatisfy employee users as it cannot be properly nested and stored.
Hazardous Failures
Due to pressure to improve cart maneuverability, the cart is so light and mobile that it is a safety risk to children who easily tip it over.
High
Failure value
Low
Low
Failure anticipation
High

Fig. 5. Envisioned innovation failure modes in a shopping cart development.

involve collecting data about the failure risk, giving the data meaning, and taking action (Daft and Weick, 1984).

The second innovation failure mode in Fig. 4 we call *hazardous failures*. In this mode, innovation failure is highly anticipated, and the expected value attributed to the failure is very low as the failure is likely harmful. Hazardous failures are commonly observed in high-risk innovation efforts, such as developing and testing new drugs or vaccines, where experimentation and failure are intrinsic to the process (Khanna et al., 2016). In such contexts, firms strive to fit their activities and objectives well. However, they often face challenges in attaining this alignment due to an uncertain environment or the need for rapid product development. The inherent risks and uncertainties associated with these endeavors make failure a possible outcome that is expected and accounted for in the innovation process. For instance, failures like unwanted knowledge spillovers or other challenges that arise while collaborating with essential partners in joint innovation projects are anticipated and calculated (Lhuillery and Pfister, 2009), but the value derived from these failures is generally low, as they offer limited learning opportunities. By recognizing and embracing the possibility of failure in these contexts, organizations can better navigate the innovation process, learn from setbacks, and ultimately enhance their chances of achieving breakthrough innovations.

For the IDEO cart, if we reconsider the excursive failure mode example (i.e., lighter weight and more maneuverable cart that is also a tipping risk for children) but then assume that this innovation failure is not identified and not repurposed, it is a hazardous failure mode. If the innovation is not adapted and diverted to be sold and used in child-free transportation contexts and ends up being used in supermarkets, then it becomes an unsafe and dangerous innovation failure. This failure mode can arise when the pressure to prioritize a particular design feature for a specific user group becomes overwhelming, resulting in the neglect of considerations and testing for potential side effects. The pressure from one type of user for one design feature is so high that consideration and testing for side effects are neglected.

An effective response to this mode would be *predict-modify-mitigate*. Prediction entails using sensemaking and modeling methods to forecast future hazardous failures based on historical and current data about the innovation process. Given the risks of this mode of failure, this response involves 'intruding actively' (Choo, 2001) into possible causes and effects of failure. For example, the use of advanced data analytics to uncover the relationships and patterns between different types of failure across the process (Kelleher et al., 2020) or some form of double-loop learning that rethinks and changes process assumptions and practices (Argyris, 1977). The insights from prediction would lead to learning and modifying the process, and innovation, to mitigate the occurrence and impact of future hazardous failures. This mode involves taking steps to foresee the failures, determine why they occur, and then change the process to thwart future occurrences. This can be done by closely examining the failures of other firms in the same sector or by examining their own failures (Baum and Dahlin, 2007), e.g., via checklists and protocols (Degani and Wiener, 1993; Thomassen et al., 2014).

Our typology's third mode of innovation failure occurs when the likelihood of failure anticipation is low and failure value is high. Low anticipation means that firms are not expecting innovation failure to occur and are focused on other process-related issues and events. However, if this mode of failure does occur, then its value is highly evident, and managers are likely to decide to learn from it (Dahlin et al., 2018), including attributing the failure to external causes such as luck or good conditions (cf. Jones and Harris, 1967). As this failure mode benefits the innovation process, we call it the *fortuitous failure* mode. Firms feel lucky when such failures occur. Despite being accidental, serendipitous, and surprising, when this mode of failure happens, a firm's ability to capitalize from this failure is high (Busch, 2022).

In the IDEO shopping cart example, a fortuitous failure would be if the innovation team ignored the views of supermarket employees and only focused on customer needs. This omission impacts the problem

discovery and definition phases of the innovation process, as the perspectives and needs of employees are not adequately considered. However, the resulting outcome could likely be fortuitous due to chance or luck rather than intentional design, with the final shopping cart inadvertently addressing supermarket employees' unstated needs and preferences. For instance, a design feature intended to help customers find and use carts may also make it easier for employees to deal with the unstated problems of cart storage.

An effective learning response to the fortuitous mode of failure would be *probe-expose-extrapolate*. These activities entail what Daft and Weick (1984) call 'enacting' as managers actively prospect for information that could induce value from such failure events. It also involves creating process phase conditions that allow such failures to emerge, be discovered, and extrapolated for value. Although cultivating serendipity is a paradox (Cunha et al., 2010, 2015), firms can learn to do so (Busch, 2022) in a way that failures are less surprising and perhaps even somewhat intentional, as per the fourth mode in our typology. Prerequisites for cultivating serendipity include individuals being able to recognize failures and connect them to the context; and at the organizational level, having mechanisms for resource allocation and social integration in place (Busch, 2022). Probing for and exposing fortuitous failures could entail doing tasks that Sutton (2001) refers to as 'following weird rules for creativity' and ignoring conventions for what works typically. Also, cultivating this form of failure by developing preparedness and exposure to failure will raise its value (Busch, 2022; Busch and Barkema, 2021). Once this mode of failure occurs, firms anticipating value from it will systematically extrapolate learning.

Our typology's fourth mode of innovation failure, *excursive failures*, occurs when the likelihood of failure anticipation and failure value are both high. Firms expect and seek out failures in the hope that they will be of value to the firm. This mode is excursive in that openness to failure helps trigger innovation activities to switch directions and follow a new path to the same or different goals. This mode likely benefits from firm responses facilitating this hoped-for positive failure through daring exploration and experimentation. The excursive failure mode recognizes that failures are not always setbacks or obstacles to be avoided but can be important catalysts for learning and progress. Organizations that proactively address failures, supported by strong innovation capabilities (Chatterjee et al., 2023) and a diverse project portfolio that spurs resilience (Leoncini, 2016), can extract valuable insights, enhance their strategies, and achieve better innovation results.

For the shopping cart example, an excursive failure mode could involve selecting a solution that allows the cart to steer more easily, but a negative and unintended side effect might be that it also introduces a safety risk for children. However, the enhanced maneuverability and lightness that pose a risk to child safety in a supermarket setting might have value and no safety concerns in other contexts. This example of an excursive mode of failure involves 'Walpolian serendipity' (Yaqub, 2018), which is when a targeted line of innovation enquiry (i.e., designing a more steerable shopping cart) results in a failure that leads to a solution for a new problem (i.e., a cart for non-shopping applications). Another excursive failure associated with the IDEO cart example was the built-in barcode scanner for customers to scan items as they shopped. Supermarkets initially rejected this cart feature, but later some adopted it as an intermediary innovation en route to the advent of self-checkouts in stores.

An effective learning response to the excursive mode of failure would be *facilitate-analyze-harness*. This response to process-level failure involves learning by doing, for example, launching a new product to see what the market thinks, rather than waiting for research that suggests what the market wants (Choo, 2001). The facilitation aspect of this response involves ensuring those involved in the innovation process have the psychological safety needed to look for, reveal, and learn from failure (Edmondson, 2002). Learning from failure can be troublesome, involving a risky and emotionally stressful process (Dahlin et al., 2018; Sitkin, 1992), and psychological safety helps to overcome the fears and associated inaction linked to such risks. This requires firms to have veracity related resources and capabilities to make sense of and capture value from the failure data (Cappa et al., 2021). Especially after-event analysis and error management have effectively enhanced learning from failure (Dahlin et al., 2018). Harnessing is a value capture activity. In other words, this mode deploys resources and practices to actively anticipate and secure appropriate returns from this failure mode (Chesbrough et al., 2018).

4. Discussion

Like the focus of this Special Issue, our paper is motivated by calls for a better understanding of the diversity of innovation failure and its impacts (Baxter et al., 2023; Forsman, 2021; Hartley and Knell, 2022; Testa et al., 2022; Maslach, 2016). More specifically, and as developed from our scoping review, we focused on the question: How can we use process theorizing to understand failure diversity within and from the innovation process? Based on our synthesis of multiple bodies of literature, we define innovation process failure as involving one or more task failures and outcome failures combining within the process to result in a mode of failure that prevents the attainment of expected innovation goals. From this, we argue that firms will more likely anticipate and value task failures in general and more likely anticipate and value failures within the divergent phases and the earlier phases of the innovation process. We then present four modes of innovation failure and associated responses that can arise from differences in anticipating and valuing failure within the process. Now, using the three themes (causes, effects and learning) identified from our scoping review, we explain the theoretical implications of these contributions and offer suggestions for future research. We also explain how our work can help managers understand and manage innovation failure.

4.1. Theoretical implications

Research on Theme 1, the causes of innovation failure, investigates the reasons for innovation failure –from a firm-level or a market viewpoint. This "not success" outcome-oriented research is variance in nature as studies tend to examine how a single cause correlates with a single process-level failure. For example, how a defective business function (e.g., marketing, forecasting, finance, etc.) (García-Quevedo et al., 2018; Santamaría et al., 2021), an adverse organizational incident (Forsman 2021) or an unfavorable market condition (Heidenreich and Kraemer, 2016; Pellegrino and Savona, 2017), might lead to innovations not being developed or not being successful in the market. Our work, in contrast, provides a more nuanced and contingent conceptualization that assumes causes and failures are not a single event. Instead, there is a 'journey' of problems producing different types and failure modes. Task and outcome failures occur, connect, and transition within and across process phases. Therefore, the causes of failures may vary, particularly when considering the existence of different types of failures within and across the phases of the process. This flow of failures eventually results in a specific mode of process failure characterized by how anticipated and valued it is.

Our process model is also a roadmap for researchers to understand how failures emerge and cascade (Goodman et al., 2011), through a process. Much like the 'Swiss cheese' model for how safety incidents arise (Reason, 1990), each phase in our process model would consist of slices of Swiss cheese, each with holes. The holes in the Swiss cheese slices depict the risks of different task and outcome failures that could occur during a phase. Even with checks, detections, and responses to failures at all phases, failures can still occur in one phase and flow through to later phases without being identified. This potential for failures to journey through each phase of an innovation process is comparable to the holes in each slice of multiple slices of Swiss cheese being aligned. This perspective goes beyond simplistic and static understandings of the concept (Langley et al., 2013). It is a

conceptualization that addresses calls to understand how failure emerges and transitions across the work activities in a process (Lei and Naveh, 2023).

Our research also has implications for the second theme in our review, understanding the effects of innovation failure. Prior research on this theme examines how firms view and are impacted by the concept (e.g., Liao and Cheng, 2014; Leoncini, 2016; Ferreira et al., 2020). Our contributions advance this work in two ways. First, the attention-based view (Ocasio, 1997) and attribution theory (Ilgen and Davis, 2000; Weiner, 1972) specify two stances to innovation failure - anticipation and value - that theoretically incorporate and interrelate other singular effects. For example, the attribution stance includes the views that failure is expected (Maslach, 2016), unavoidable (Ferreira et al., 2020), and even required (Danneels and Vestal, 2020) to innovate well. Furthermore, the anticipation stance aligns with the view that failure is to be anticipated as innovation is inherently chaotic and error-prone (Bledow et al., 2009). Similarly, the value stance incorporates views that include innovation failure being a negative and harmful event that should be avoided (Välikangas et al., 2009) to being something that should be embraced and prized because of its worth (Danneels and Vestal, 2020; Ferreira et al., 2020). Together, both stances provide a theoretical logic and diagnostic function for understanding how firms view and are impacted by innovation failure based on the attention capacities and the attribution psychology of individuals involved in the process. This implication of our work is consistent with the 'failures-*as*-judgment' notion that the effects of failure are due to the perspectives of the individuals involved (Baxter et al., 2023).

Another implication of our work for the innovation failure effects theme is that the likelihood of anticipation and value towards failure is diversity and process contingent. In other words, innovation failure is not to be simply viewed as negative or positive. For instance, Khanna et al. (2016) advocate distinguishing between the effects of failure during idea generation and selection. We go further by asserting that the likelihood of anticipating and valuing failure depends on the type of failure (task versus outcome) that occurs, the process phase (divergent versus convergent) where the failure occurs, and the point in the process (early versus late) the failure occurs. More specifically, our central premise is that there will be greater anticipation and value toward task failures as these are more numerous than outcome failures and often cause outcome failures. We also propose a greater likelihood for anticipation and value in the divergent phases as they are more experimental, creative and risky than the convergent phases, and that the stances become less likely further into the innovation process due to the impact of rising sunk costs that shift an individual's attention and attribution to failure. Our process model, its constructs and the resulting propositions provide logic and terminology to facilitate a contingency oriented dialogue and empirical exploration of the effects of innovation failure.

Finally, the models and ideas in our paper add to research on the third theme, learning from innovation failure, in two-ways. As prior research on this theme draws on the other two themes, the studies focus on the responses firms adopt to learn from innovation failure (Rhaiem and Amara, 2021), to avoid innovation failure (e.g., Cannon and Edmondson, 2005; Välikangas et al., 2009) and to understand the impacts of this learning (e.g., Rhaiem and Halilem, 2023; Dana et al., 2021). By distinguishing between task and outcome failures and how they journey and cascade within a process, our contributions provide a framework for considering how learning responses should align with failure latency (Reason, 1990; Lei and Naveh, 2023). Latent failures are task and outcome failures that lie dormant and undetected or ignored in a process, until they combine with other failures to become active failures that are noticed. As latent and active failures can impact innovation outcomes, the activities in a failure learning response should align with a potential failure's visibility and risk. As we assert that task failures will likely be more numerous but more anticipated and valued relative to outcome failures, this aligns with research (and practice) for anticipating and detecting latent failures that measure the severity, the probability of occurrence, and the likelihood the failure will be detected (Qin and van der Rhee, 2021).

A second implication of our work for the learning theme is how the nature of each failure mode and its response helps explain how firms should balance failure prevention and failure management activities (Frese and Keith, 2015). When failure modes are viewed as negative, not valued and to be avoided, firms focus on designing processes and practices that focus on preventing failures from occurring (Frese and Keith, 2015). This is explained by our typology, where the response for unsolicited failures comprises activities to prevent, alert and eliminate failures, and the response for hazardous failures involves predicting, modifying, and mitigating failures. In contrast, when failure modes are deemed inevitable and potentially useful, firms will more likely manage failures by detecting, communicating, and acting on these modes. For example, consider the probe-exposed-extrapolate response for the fortuitous failure mode, and the facilitate-analyses-harness response for the excursive failure mode. Thus, as with the implications distinguishing between task and outcome failures, a one-size-fits-all learning response to modes of failure is insufficient. In other words, our typology is essentially a contingency framework for understanding and studying how different modes of innovation failure require different learning responses.

4.2. Managerial implications

Danneels and Vestal (2020, p. 16) discuss how AG Lafley, the former CEO of P&G, said, "The topic of failure is very important, and it gets more lip service than good practice". They link this lack of good practice to a dearth of research-informed guidance on how to manage innovation failure. Our ideas and models guide a core problem managers face when dealing with innovation failure - how to make sense of and manage this complex, uncertain, risky and potentially rewarding concept. Our work provides this guidance in two fundamental ways.

First, our process and contingent conceptualization of innovation failure helps managers understand that it rarely should be managed as a single uniform event that results in a standard form of failure from the process. Instead, innovation failure comprises types that journey within the process to produce modes of failure from the process. This view helps managers align the complexity and dynamics of innovation failure to how they view and respond to the causes effects, and learning responses of the concept. For example, managers could investigate how rule-based causes (i.e., not following procedures for doing a task or selecting an outcome) and capability-based causes (i.e., not having the right people with the right skills and knowledge) (Dahlin et al., 2018; Rasmussen, 1982) vary for different types of failure at different points in the process. Similarly, managers could investigate how failure intentionality changes within the process. How might the propensity for unintended human errors, such as slips, lapses and mistakes, versus intended violations, such as sabotage (Reason, 1990), vary within the process and for different failure types. Such analysis could determine how to design and manage innovation processes to prevent and learn from innovation failure. Employee training and selection could be geared towards having individuals with the right failure anticipation and value mindset at different points in the process. For example, individuals who are open-minded to unusual task outcomes and comfortable reporting failures, whether their own or observed in the process. Ensuring that anticipation and attention stances are aligned with failure-process conditions can promote proactive communication about causes and risks that develops a failure management competency for making sense and managing innovation failure (Rybowiak et al., 1999).

Our second core practical implication is also contingency-oriented in that our typology provides a comparative framework to help manage modes of failure arising from the innovation process. The typology describes four modes and associated responses that managers may not have considered. Managers who have led innovation projects where failure is typically not tolerated (e.g., healthcare innovation) may need

to modify how they view and manage failure in other project contexts (e.g., consumer products) that accept or even welcome failure. Also, managers could use analytical methods to identify potential modes of failure and adopt suitable learning responses. This could involve using failure mode and effects analysis (Stamatis, 2003; Liu et al., 2019) to identify and rank types of failures according to their probability of occurrence, detectability, and severity, to identify potential modes of failure.

Learning from failures is challenging, partly due to employees' reluctance to report them (e.g., Edmondson, 1996; Sitkin, 1992). Consequently, when different modes of failure arise or are anticipated, managers should foster communication and judgment processes suited to the failure mode's conditions. This would include customizing post-event investigations that align with the anticipation-value stances underlying each mode to ensure tailored learning and improvement (Dahlin et al., 2018). Additionally, using our typology to develop training to identify and analyze real-life modes of innovation failures could be valuable. This would not only prepare innovation teams for a variety of failure possibilities but also encourage proactive thinking and strategic planning. In sum, our typology provides managers with a framework to guide how they assemble, train, and support innovation teams to deal with different modes of failure in line with industry and innovation goals. This would help steer unproductive finger-pointing toward more contingent, meaningful learning responses to innovation failure. Moreover, all these insights and feedback from practitioners in real-world settings could be valuable for future research to refine and improve the proposed innovation failure model. Methods like expert group discussions, focus workshops, or ethnographic documentation of innovation processes in action could be particularly effective in this endeavor.

4.3. Limitations and future work

Like any conceptual study, our work has shortcomings, which can serve as starting points for future research. While we theoretically grounded and illustrated the ideas and dimensions in our process model and typology, we do not empirically test them. Furthermore, all conceptual models are interpretations of a reality that cannot be simultaneously general, accurate, and simple (Daft and Weick, 1984; Thorngate, 1976). As the models in our paper strive to be general and simple, we now discuss some future research opportunities to enhance their accuracy by considering different innovation failure contexts, along with more complex process interpretations and multiple levels of analysis.

Regarding context, we hope future research will apply and refine our ideas in a range of settings. These include industries with different tolerances for failure (e.g., healthcare versus consumer electronics) (Maslach, 2016; Heidenreich and Kraemer, 2016), innovations with different magnitudes (i.e., incremental versus radical) and directions of change (i.e., continuous versus discontinuous) (McCarthy et al., 2010), and different strategic approaches to innovation (e.g., open innovation, user innovation, and innovation push versus pull strategies) (Bogers et al., 2017; Chesbrough et al., 2006). Each of these contexts will involve different conditions that could impact the anticipation-value stances to innovation failure. The conditions will also likely mean that task and outcome failures occur with varying frequency, detectability, and severity. Applying our models to understand these contextual variations could provide deeper insights into how task and outcome failures occur and combine and journey through an innovation process.

While our approach to process theorizing is intentionally linear, it's important to acknowledge other styles of process theorizing, such as parallel, recursive, and conjunctive (Cloutier and Langley, 2020). In pursuit of more accuracy, the logic and detail in our models could be developed to capture the iterative and potentially chaotic nature of innovation processes (McCarthy et al., 2006). For example, feedback loops could be incorporated to reveal the dynamics within the process that explain the causes, effects, and responses to innovation failure. This approach would be recursive process theorizing in that it views "processes as ongoing cycles of adaptation and/or reproduction" with an "underlying assumption that 'things do not end here' and that the process continues" (Cloutier and Langley, 2020, p. 11). This inclusion of feedback, analysis, and adjustment would be essential to help develop further theoretical and practical insights about innovation failure.

Finally, as our models and ideas focus on process level of analysis and how individuals anticipate and value failure, other levels could also be considered. For instance, how the systems and behaviors at team and organizational levels impact the causes, effects, and response to innovation failure. Team-level anticipation to failure could be measured by how much attention team members pay to different types of information (Rhee and Leonardi, 2018). Innovation teams could specify their information focus and sharing extent using techniques like 'think-aloud' (Grégoire et al., 2010), and surveys that are supplemented with archival or textual data (Hansen and Haas, 2001; Piezunka and Dahlander, 2015). Similarly, a team's value stance to failure could involve using ethnographic methods to explore a teams' attributed causes and their narrative strategies (Forsman 2021; Mantere et al., 2013). Future research could also move up from the process level to examine the impact of organizational psychological safety (Edmondson and Lei, 2014), incentives (Kamoto, 2017), culture (Danneels and Vestal, 2020), and research collaborations (Santamaría et al., 2021) and refine our process conceptualization of innovation failure.

5. Conclusion

Our process theorizing of innovation failure leads to a model that distinguishes two types of innovation failure that journey and combine within the process. Anticipation and value to these failures depend on the type of the failure and where within the process it occurs. These ideas guide a typology of four modes of innovation failure and associated learning responses that arise from the process. We hope these contributions about the diversity and flow of innovation failure will stimulate and guide future research and management practice on the causes and effects of and learning from the concept.

CRediT authorship contribution statement

Elena Freisinger: Conceptualization, Writing – original draft, Writing – review & editing. **Ian P. McCarthy:** Conceptualization, Writing – original draft, Writing – review & editing.

Data availability

No data was used for the research described in the article.

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